EXP-35
February 15, 1973

ACCELERATOR EXPERIMENT--More Booster Beam Decay

Experimentalists: E. Hubbard, E. Gray, T. Collins

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A second installment of booster beam decay was given in Experiment 32 and the February 7 staff meeting. Because of questions about the apparent slow rise time of the charge monitor and possible saturation problems, more dc beam decay investigations were made.

An effect on beam decay due to a partially filled ring has been observed and is discussed below.

DATA

An attenuator of 6db was put in to insure that there were no saturation problems in the charge monitor. A slow rise time was not observed on the charge monitor, as was previously seen.

Figure A shows beam loss for several sextupole current levels with a full ring of injected beam. The normally used 25-amp sextupole current level did not result in the smallest beam decay rate. This result does not agree with earlier dc observations. Further investigation showed that the results do not repeat unless the chopper and injection kicker are timed so that the booster ring is only partially filled.

Figure B shows the first recorded effect of a partially filled ring. The charge monitor has a time constant of about 10 microsec, so that it does not see variation of charge in individual turns but only the average amount in the ring. Figure C shows a still larger notch in the beam with less than half of the ring filled initially. In this case, the results were reproducible. The normally used sextupole current of 25 amps is seen to be best in agreement with earlier dc results

and with ac experience.

Figure D shows the effect of turning on a constant-frequency RF.

Figures E, F and G show the L20 toroid beam detector, which has a time-constant response of about 1 microsecond, and therefore sees some of the single-turn structure. The figures are copies of Polaroid pictures and the internal structure is only seen as an increase in trace width. Figure G shows structure in the beam with RF off and a nearly full ring. There is always a very small notch because the ring cannot be completely filled at injection. The beam seems to remember an initial notch of significant size, even though Figure F indicates the notch decays early in the cycle.

With RF on, a notch in the beam is preserved during the whole cycle. Thus, in Figure E, the notch lives the whole cycle. With RF off, the notch decays in about 3 milliseconds. However, little structure remains after the decay, unlike the no-notch case in Figure G. Note the current level at the end of the cycle in Figure F is close to twice that of Figure E because of the peak reading effect of the toroid. The ring is only half full in in Figure E because of the preserved notch.

Figure H shows the charge monitor for very long times with all extraction devices turned off. The overshoot due to the time response of the detector is also seen.

CONCLUSIONS

i) The earlier data on beam decay were essentially correct.
   a. The dc-RF-off loss is very small compared to ac loss.
   b. In the ac field case, there is no difference in the early decay between RF-off and -on.

ii) The dc-RF-on loss is much larger than dc-RF-off.

iii) The ac loss is still larger than the dc-RF-on loss.

iv) For consistent, seemingly reliable results, a partially filled ring was found necessary in the dc field studies.

v) The time constant of the detector is 1.44 sec. When the data in Figure H is corrected for the detector response, the beam decay is exponential with a meanlife of .89 sec.

E. Gray

cb

Charge Detector (Attenuation 6 db)
dc Field - RF off - Full Ring

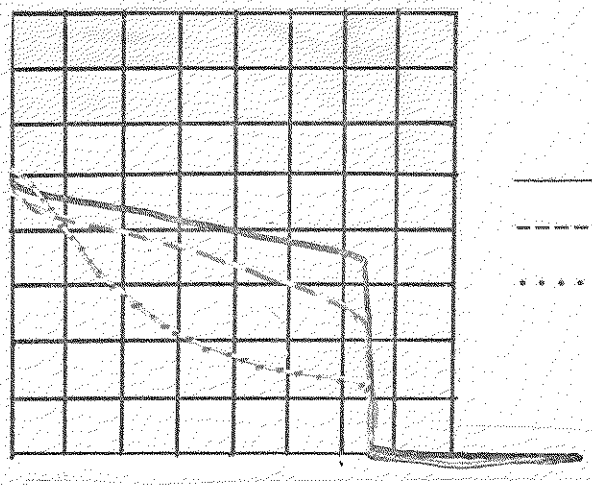


FIGURE A. 1V/div.

5 ms/div.

Charge Detector
RF off

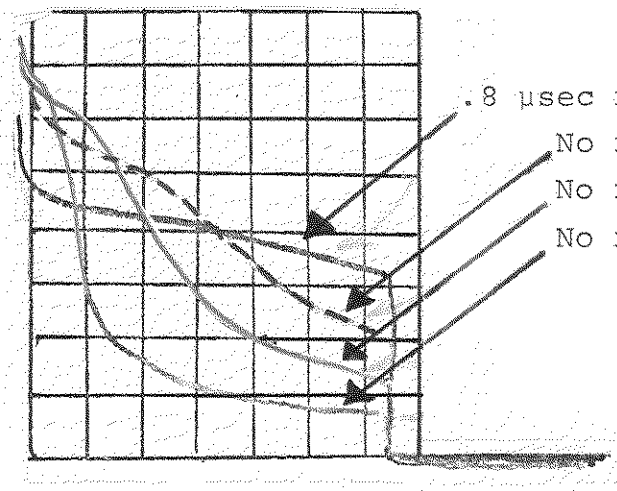


FIGURE B. 1V/div.

5 ms/div.

Charge

RF off - Notch 1.8 μsec.

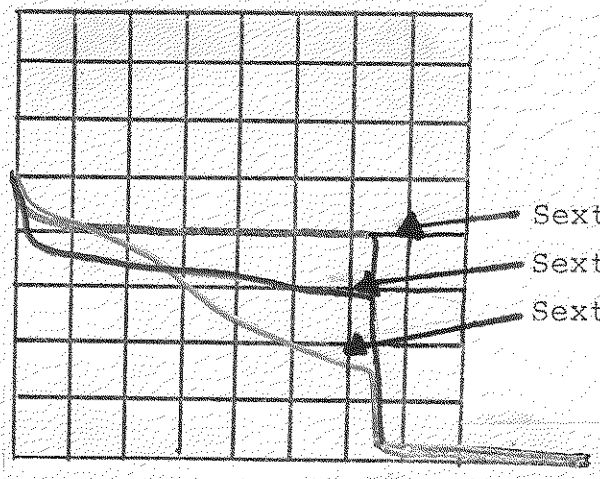


FIGURE C. .5V/div.

5 ms/div.

Charge

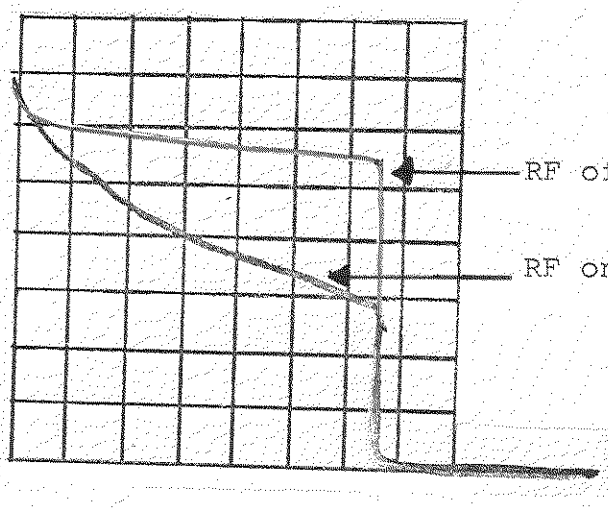


FIGURE D. .2V/div.

5 ms/div.

FIGURE E. L20

RF on
1/2 ring 1V/div.

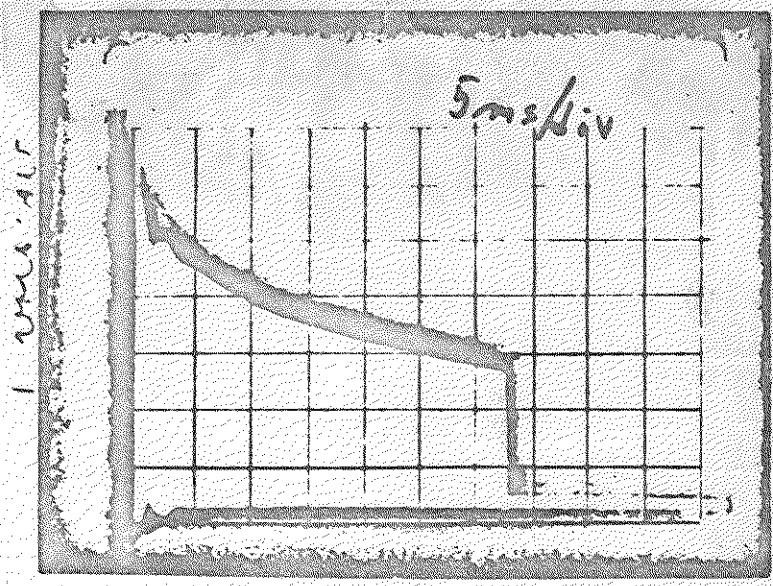


FIGURE F.

RF off
1/2 ring 1V/div.

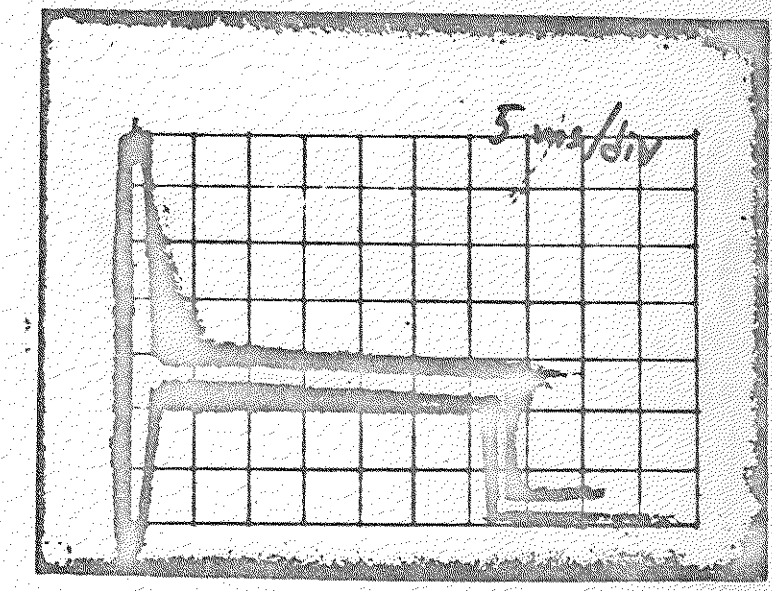
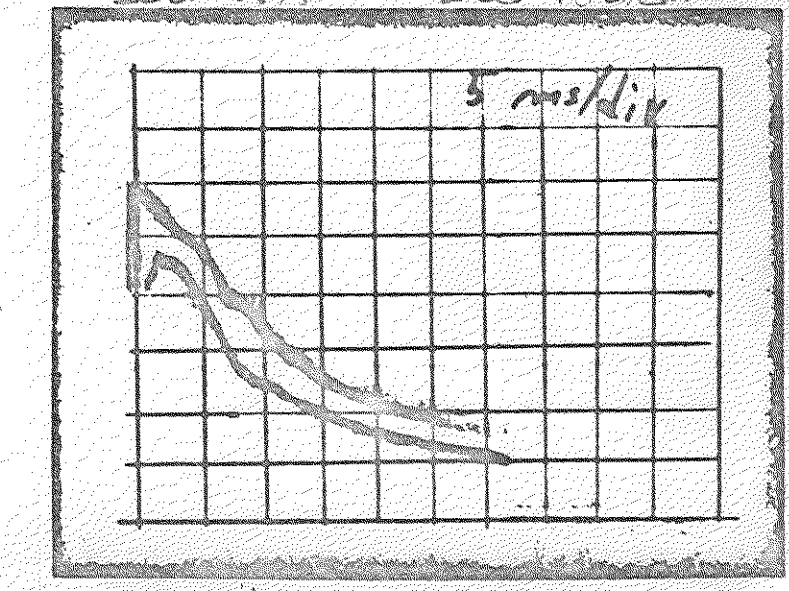


FIGURE G.

RF off
Full ring 1V/div.



Charge

RF off

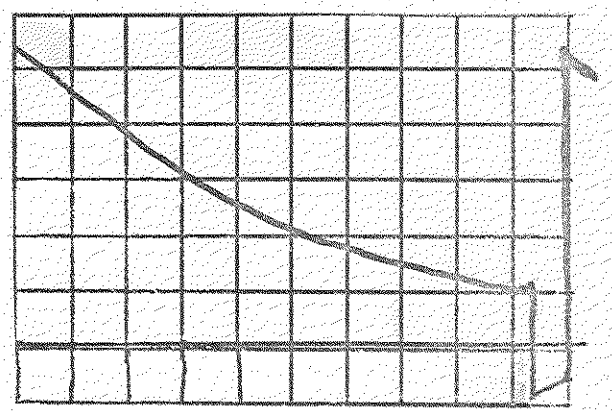


FIGURE H..1V/div.

0

.1 sec/div.